

NATIONAL
THERAPEUTIC
ARC
CARBONS



NATIONAL CARBON COMPANY, INC.
Carbon Sales Division
CLEVELAND, OHIO, SAN FRANCISCO, CALIF.
Unit of Union Carbide and Carbon Corporation

DEPARTMENT OF COMMERCE
Bureau of Standards
Washington

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Paragraph 16. *Carbon Arc Found to be Closest Approach to Sunlight*

At the present time great efforts are being made by the medical profession to utilize sunshine to the best advantage for healing purposes. Proof of this is found in the thorough search now being made for a window material that will transmit the shortest ultra-violet solar rays to which ordinary window glass is opaque. However, sunshine is not available at all times and in every desirable place. Hence the Bureau has been investigating the spectral energy distribution of various artificial illuminants to find the one which most closely approaches the ultra-violet spectral energy distribution of the sun.

Such a source has been found to exist in the carbon arc. Of all the artificial illuminants tested it is the nearest approach to sunlight. The observations, as a whole, showed that the ultra-violet radiation emitted is a complex function of the electrical current through, and the chemical composition of, the electrodes. The high-intensity arc, using 90 to 125 amperes, will be useful in large installations. By choosing the proper kind of cored carbon electrodes, and the proper working distances, the same relative proportions of ultra-violet and total radiation can be obtained from a 20-ampere arc as from the high-power installation. This is fortunate as it will be possible to meet all requirements in light therapy.

NATIONAL THERAPEUTIC ARC CARBONS

WITH a background of many years of experience in the manufacture of arc carbons for every purpose, National Carbon Co., Inc., has recently completed extensive studies and tests in the application of arc carbons to light therapy.

This experimental work has resulted in the perfection of arc carbons of proved therapeutic value. The various types are classified as National Therapeutic "A", "B", "C", etc., and explained in detail in the text that follows. They are adapted for use in all Therapeutic Arc Lamps.

With any one arc lamp and the selection of the proper type and size of National Therapeutic arc carbons any of the light conditions shown by the accompanying Spectrograms is easily produced.

National Therapeutic "A" Carbon

This carbon contains rare earth compounds. It gives a bluish-white light when properly burned. The energy radiated from this arc consists qualitatively of a spectrum of thousands of lines that give practically as continuous a spectrum as does sunlight. These lines extend from the infra-red through the visible and ultra-violet to approximately 2800 AU with scattered lines extending to wave lengths shorter than 2000.

Quantitatively this arc gives much energy in the infra-red, visible and near ultra-violet regions to about 2900 AU. Comparatively little energy of wave lengths shorter than 2900 is emitted. The greatest quantity being in the short visible and near ultra-violet region, it is therefore very much like sunlight.

For a given input of electric energy this arc is more nearly like sunlight than any other arc or any other light source. At large currents and high current densities such as used in the "High Intensity" lamps, the light produced is a very close reproduction of noon June sunlight. The High Intensity arc to which we refer is used in the large searchlights operated by the Army and Navy, in the floodlights used to illuminate the large air mail fields and in the lamps used for projecting the pictures in large motion picture theatres.

In a very broad and general way a 30-ampere arc, with reflector, burning a 13-mm. carbon of this type, gives, at about 30 inches from the arc, a quality and quantity of energy similar to a perpendicular exposure and noon June sunlight. A 15-ampere arc with 10-mm. carbons of this type gives, with a reflector, a similar quality of light in approximately one-fifth this quantity. A 10-ampere arc with 6-mm. carbons of this type, without any reflector, gives approximately one twenty-fifth this quantity of energy at this distance. This data will enable dosage to be determined by those who are

familiar with the practice of heliotherapy or sun therapy by keeping in mind that the concentration of energy from an arc varies roughly inversely as the square of the distance from the arc.

This carbon is a general purpose carbon and can be used where the object is to reproduce sunlight and the general physiological effects caused by sunlight. The light from this arc will produce an erythema and eventually will produce a tan.

For alternating current both carbons should be of the same size and kind. The following table will indicate suitable sizes for different currents.

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm.
6 to 10	6 mm.
10 to 15	8 mm.
15 to 20	10 mm.
20 to 35	13 mm.
35 to 50	16 mm.
50 to 90	13 or 16 mm. copper coated

The arc voltage on AC should be about 30 to 40 volts. With current above 30 amperes these voltages should be somewhat increased.

On direct current the voltages should be similar to the AC voltages. The sizes listed for AC trims can be used on DC also, but perhaps a better arc operation can be obtained by using a negative that is smaller in diameter in most cases.

The following table indicates sizes for direct current.

<i>Direct Current Amperage at Arc</i>	<i>Diameter of Carbons</i>	
4 to 6	5 mm. A Positive	5 mm. A Negative
6 to 10	6 mm. A Positive	5 mm. A Negative
10 to 15	8 mm. A Positive	6 mm. A Negative
15 to 20	10 mm. A Positive	8 mm. A Negative
20 to 35	13 mm. A Positive	10 mm. A Negative
35 to 50	16 mm. A Positive	13 mm. A Negative
50 to 90	16 mm. A Positive	13 mm. A Negative copper coated

National Therapeutic "B" Carbon

The National Therapeutic B Carbon contains iron. The flame of this carbon is not particularly blue but it gives a little light of a bluish tinge. The general color of the visible light is similar to that from Therapeutic A carbons, but has a candle power of less than one-fourth than from the A carbons for similar conditions of electrical current consumption.

The spectrum of light from this arc is qualitatively characterized by many lines that extend from the visible through the ultra-violet to 2300 AU or shorter. Quantitatively it is comparatively weak in the visible part of the spectrum and very strong in the short ultra-violet region. It gives much light in the region from 2300 to 3000 AU.

Light from this arc is in general more similar qualitatively to light from the quartz mercury arc which is widely used in light therapy. Quantitatively the amount of ultra-violet light from most Therapeutic B arc trims is greater than from most mercury arcs because of the customarily larger electric energy consumption in the carbon arc.

This arc can be used when the object of treatment is to produce an erythema. Light from this arc is applicable in the general type of cases where the mercury arc is useful.

Light from National Therapeutic B Carbons is particularly powerful in causing conjunctivitis. Therefore every opportunity should be taken to impress on the mind of the user the necessity of protecting the eyes when using this carbon. Protection for the eyes is required when working with

any therapeutic carbon. Therapeutic B requires special caution in its use.

On alternating current the two carbons should be of the same kind and size. A table of sizes for B carbons follows:

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm.
6 to 10	6 mm.
10 to 15	8 mm.
15 to 20	10 mm.
20 to 35	13 mm.
35 to 50	16 mm.
50 to 90	13 or 16 mm. copper coated

The arc voltage should be about 30 or 40 volts at currents up to 30 amperes, above this the voltage should be somewhat increased.

On direct current best results will be obtained by using an A or D negative of smaller size. The following sizes are recommended:

<i>Direct Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm. B Positive 5 mm. A or D Negative
6 to 10	6 mm. B Positive 5 mm. A or D Negative
10 to 15	8 mm. B Positive 6 mm. A or D Negative
15 to 20	10 mm. B Positive 8 mm. A or D Negative
20 to 35	13 mm. B Positive 10 mm. A or D Negative
35 to 50	16 mm. B Positive 13 mm. A or D Negative
50 to 90	16 mm. B Positive 13 mm. copper coated B Negative only

The arc voltage should be 30 to 40 volts at currents less than 30 amperes if an A negative is used and 40 to 50 if a D negative is used. At higher currents somewhat higher voltages are necessary.

National Therapeutic "C" Carbon

National Therapeutic C Carbon is a "poly-metallic" type of carbon in which several metals are used in the core. In this case the metals are iron, nickel and aluminum. Silicon is also present in this carbon.

This carbon is designed to produce the maximum quantity of ultra-violet light. The carbon gives ultra-violet in large quantities as do some others — Therapeutic B and G particularly but Therapeutic C gives a more even distribution of light through the entire ultra-violet range than either of these. This carbon gives more nearly equal quantities of ultra-violet throughout the physiologically active range than any other.

The same care to protect the eyes must be used when burning this carbon as is found necessary when burning the Therapeutic B Carbon.

Suitable sizes for use with various alternating currents are indicated in the following table:

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm.
6 to 10	6 mm.
10 to 15	8 mm.
15 to 20	10 mm.

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
20 to 35	13 mm.
35 to 50	16 mm.
50 to 90	13 or 16 mm. copper coated

The arc voltage should be 35 to 45 volts at currents up to 30 amperes. At higher currents the voltage can be increased advantageously.

On direct current best results will be obtained by using an A or D negative of smaller size.

The following sizes are recommended:

<i>Direct Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm. C Positive 5 mm. A or D Negative
6 to 10	6 mm. C Positive 5 mm. A or D Negative
10 to 15	8 mm. C Positive 6 mm. A or D Negative
15 to 20	10 mm. C Positive 8 mm. A or D Negative
20 to 35	13 mm. C Positive 10 mm. A or D Negative
35 to 50	16 mm. C Positive 13 mm. A or D Negative
50 to 90	16 mm. C Positive 13 mm. copper coated C Negative only

The arc voltage should be 35 to 45 volts at currents less than 30 amperes if an A negative is used and 40 to 50 if a D negative is used. At higher currents higher voltages can be used to advantage.

National Therapeutic "D" Carbon

The National Therapeutic D Carbon contains an alkali silicate as an arc supporter. The flame of this arc is nearly colorless or faintly violet. The spectrum consists of a few groups of lines on a continuous background. Most of the energy is in the red, infra-red, and near ultra-violet region. The ultra-violet light is confined almost exclusively to the region of 3500 to 4200 AU.

It is difficult to predict just to what use these carbons can be applied. They are included in this list because they are being used by physicians with some clinical success. Some physicians demand them. We are not at present in a position to state that they are not the best thing to use in any given case. There is some short wave ultra-violet in these arcs but the quantity is comparatively small.

The voltage on alternating current should be 40 to 50 volts across the arc; at currents above 30 amperes the voltage should be somewhat increased.

On alternating current two carbons of the same size and kind should be used. A table of sizes follows:

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm.
6 to 10	6 mm.
10 to 15	8 mm.
15 to 20	10 mm.
20 to 35	13 mm.
35 to 50	16 mm.
50 to 90	13 or 16 mm. copper coated

On direct current the arc voltages should be the same as for alternating current. Two carbons of the same kind but of different sizes should be used as in the following table:

<i>Direct Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm. D Positive 5 mm. D Negative
6 to 10	6 mm. D Positive 5 mm. D Negative
10 to 15	8 mm. D Positive 6 mm. D Negative
15 to 20	10 mm. D Positive 8 mm. D Negative
20 to 35	13 mm. D Positive 10 mm. D Negative
35 to 50	16 mm. D Positive 13 mm. D Negative
50 to 90	16 mm. D Positive 13 mm. D Negative copper coated copper coated

National Therapeutic "E" Carbon

The National Therapeutic E Carbon contains strontium. The flame of these carbons is red. The spectrum consists of lines in the red and in the extreme violet. The ultra-violet is relatively weak in these carbons but large quantities of long wave red light are emitted.

These carbons should be useful where the object of treatment is to apply heat to underlying tissues while giving the surface a small dose of ultra-violet light.

On alternating current these carbons should be burned at 30 to 35 volts at the arc at currents of less than 30 amperes and above 30 amperes at slightly higher arc voltages. On alternating current these electrodes should be of the same size and kind as indicated below:

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm.
6 to 10	6 mm.
10 to 15	8 mm.

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
15 to 20	10 mm.
20 to 35	13 mm.
35 to 50	16 mm.
50 to 90	13 or 16 mm. copper coated

On direct current these carbons can be burned in trims as listed below. The arc voltage should be 30 to 35 for the A-negative E-positive trims and 40 to 45 for the D-negative E-positive trims. For higher currents than 30 amperes the voltage must be somewhat increased.

<i>Direct Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm. E Positive 5 mm. A or D Negative
6 to 10	6 mm. E Positive 5 mm. A or D Negative
10 to 15	8 mm. E Positive 6 mm. A or D Negative
15 to 20	10 mm. E Positive 8 mm. A or D Negative
20 to 35	13 mm. E Positive 10 mm. A or D Negative
35 to 50	16 mm. E Positive 13 mm. A or D Negative
50 to 90	16 mm. E Positive 13 mm. copper coated copper coated E Negative only

National Therapeutic "F" Carbon

The National Therapeutic F Carbon contains tungsten. The spectrum of the somewhat bluish flame of these carbons consists of many lines through the entire ultra-violet region. The energy emitted by such an arc seems in at least some cases to be similar to that from the D carbons. They are demanded by some physicians who are using this type of carbon with some clinical success.

On alternating current these carbons should be burned in trims of two carbons of the same size and kind. The arc voltage should be 45 to 50 volts

at currents up to 30 amperes. For larger currents the arc voltage should be somewhat higher.

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm.
6 to 10	6 mm.
10 to 15	8 mm.
15 to 20	10 mm.
20 to 35	13 mm.
35 to 50	16 mm.
50 to 90	13 or 16 mm. copper coated

On direct current these carbons can be burned with smaller A or D negatives. The voltage at the arc should be 30 to 40 volts if A negatives are used and 45 to 50 volts if D negatives are used. At currents higher than 30 amperes these voltages should be somewhat increased.

The following table gives the proper sizes to be used:

<i>Direct Current Amperage at Arc</i>		<i>Diameter of Carbons</i>
4 to 6	5 mm. F Positive	5 mm. A or D Negative
6 to 10	6 mm. F Positive	5 mm. A or D Negative
10 to 15	8 mm. F Positive	6 mm. A or D Negative
15 to 20	10 mm. F Positive	8 mm. A or D Negative
20 to 35	13 mm. F Positive	10 mm. A or D Negative
35 to 50	16 mm. F Positive	13 mm. A or D Negative
50 to 90	16 mm. F Positive copper coated	13 mm. copper coated F Negative only

National Therapeutic "G" Carbon

The National Therapeutic G Carbon contains nickel. The light from these carbons has a slight greenish tinge. The spectrum consists of many lines through the visible and ultra-violet similar in general nature to the B carbons but the energy emitted is different. Some very strong lines at 2295 AU and a very strong band at 2900 to 3500 AU are the chief characteristics.

On alternating current the same size and type of carbon should be used in both holders. The voltage at the arc should be 30 to 40 volts for currents up to 30 amperes and slightly higher voltages at higher currents.

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
20 to 35	13 mm.
35 to 50	16 mm.
50 to 90	13 or 16 mm. copper coated

On direct current these carbons can be burned with smaller A or D negatives. The voltages should be as for alternating current, if A negatives are used. If D negatives are used the arc voltage should be about 10 volts higher.

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm.
6 to 10	6 mm.
10 to 15	8 mm.
15 to 20	10 mm.

<i>Direct Current Amperage at Arc</i>		<i>Diameter of Carbons</i>
4 to 6	5 mm. G Positive	5 mm. A or D Negative
6 to 10	6 mm. G Positive	5 mm. A or D Negative
10 to 15	8 mm. G Positive	6 mm. A or D Negative
15 to 20	10 mm. G Positive	8 mm. A or D Negative
20 to 35	13 mm. G Positive	10 mm. A or D Negative
35 to 50	16 mm. G Positive	13 mm. A or D Negative
50 to 90	16 mm. G Positive copper coated	13 mm. copper coated G Negative only

National Therapeutic "H" Carbon

The National Therapeutic H Carbon contains a calcium compound. The light from this carbon is a mixture of red and green which gives the eye the impression that the light is yellow. The spectrum consists of broad bands in the red and green region which emit most of the energy. The rest of the spectrum is decidedly discontinuous. The ultra-violet percentage is comparatively small.

These carbons are good sources of visible and infra-red energy combined with a small amount of ultra-violet. They are being used by some physicians.

On alternating current these carbons should be burned at 30 to 35 volts across the arc. With currents larger than 30 amperes the voltage should be somewhat increased. On alternating current the electrodes should be of the same kind and of sizes indicated in the following table:

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
10 to 15	8 mm.
15 to 20	10 mm.
20 to 35	13 mm.
35 to 50	16 mm.
50 to 90	13 or 16 mm. copper coated

A smaller carbon can be used for the negative in the direct current trims. On direct current the voltage should be 30 to 35 volts for H-positive H-negative or H-positive A-negative trims and 40 to 45 volts for H-positive D-negative trims.

<i>Alternating Current Amperage at Arc</i>	<i>Diameter of Carbons</i>
4 to 6	5 mm.
6 to 10	6 mm.

<i>Direct Current Amperage at Arc</i>		<i>Diameter of Carbons</i>
4 to 6	5 mm. H Positive	5 mm. A, D or H Negative
6 to 10	6 mm. H Positive	5 mm. A, D or H Negative
10 to 15	8 mm. H Positive	6 mm. A, D or H Negative
15 to 20	10 mm. H Positive	8 mm. A, D or H Negative
20 to 35	13 mm. H Positive	10 mm. A, D or H Negative
35 to 50	16 mm. H Positive	13 mm. A, D or H Negative
50 to 90	16 mm. H Positive copper coated	13 mm. copper coated H Negative only

National Therapeutic "K" Carbon

National Therapeutic K Carbon is a carbon cored with cobalt. This carbon gives a spectrum with about as many lines in the ultra-violet region as

are found in the spectrum of the B or G carbons. They are found in different parts of the spectrum and their energy distribution is considerably dif-

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ferent. In the light from these carbons considerable energy of wave lengths from 3100 to 3500 AU is found.

The chief physiologically active part of this light is in the extreme short wave length region. A higher proportion of the ultra-violet light is of wave lengths below 2500 AU than for any of the other carbons. It is therefore more nearly like the Kromayer water cooled mercury arc than any other carbon arc so far developed.

These very short ultra-violet waves are quite destructive in their action. Probably this carbon should be used with all the precautions and only in types of cases similar to those found suitable for employing the water-cooled mercury arc.

On alternating current the electrodes should be both K electrodes. The voltage should be 35 to 45 volts at currents up to 30 amperes. At higher currents higher voltages could be advantageously used.

The following table gives the proper sizes of carbons for use with alternating current:

*Alternating Current
Amperage at Arc*

4 to 6
6 to 10
10 to 15
15 to 20
20 to 35
35 to 50
50 to 90

*Diameter
of Carbons*

5 mm.
6 mm.
8 mm.
10 mm.
13 mm.
16 mm.
13 or 16 mm.
copper coated

On direct current the voltage should be 35 to 45 volts at currents less than 30 amperes if an A negative is used and 40 to 50 volts if a D negative is used. At higher currents higher voltages can be used to advantage.

Suitable sizes for use with various direct currents are indicated in the following table:

*Direct Current
Amperage at Arc*

4 to 6 5 mm. K Positive
6 to 10 6 mm. K Positive
10 to 15 8 mm. K Positive
15 to 20 10 mm. K Positive
20 to 35 13 mm. K Positive
35 to 50 16 mm. K Positive
50 to 90 16 mm. K Positive
copper coated

*Diameter
of Carbons*


5 mm. A or D Negative
5 mm. A or D Negative
6 mm. A or D Negative
8 mm. A or D Negative
10 mm. A or D Negative
13 mm. A or D Negative
13 mm. copper coated
K Negative only




THIS trade mark and the therapeutic classification appears on all National Therapeutic Arc Carbons. These carbons are highly polished and are clean to handle. Packed in quantities of 100 in convenient, corrugated cartons. Obtainable from all medical and surgical supply sources.

SPECTROGRAMS


National Therapeutic Arc Carbons
Natural Sunlight and Quartz Mercury Arc



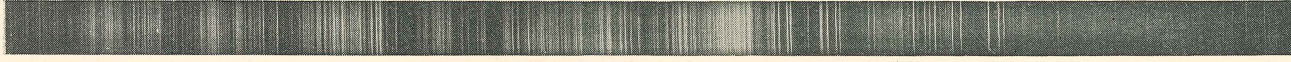
Natural Sunlight




National Therapeutic "A" Carbon




National Therapeutic "B" Carbon




National Therapeutic "C" Carbon




National Therapeutic "D" Carbon




National Therapeutic "E" Carbon




National Therapeutic "F" Carbon



National Therapeutic "G" Carbon



National Therapeutic "H" Carbon



National Therapeutic "K" Carbon



Quartz Mercury Arc

3000

ULTRA VIOLET

4000

VISIBLE

ANGSTROM UNITS (AU)

NATIONAL CARBON CO., INC.